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United States Department of Agriculture.

DIVISION OF CHEMISTRY.

CHEMICAL EXAMINATION OF CANNED MEATS.

In obedience to the request of the Secretary of Agriculture, I have secured samples of canned meats in the open market, and also certain samples furnished us by the officials of the War Department, and subjected them to a preliminary examination for the purpose of determining whether any deleterious substances have been added to them in the course of preparation to more perfectly preserve them.

In order to present the matter as fully as possible, I may say that the object of preserving meat in air-tight packages is to secure its consumption in localities where the shipment of fresh meat is not practicable. This is particularly true of meats to be used on shipboard during long voyages; in logging, lumber, and hunting camps; in armies marching at long distances from the source of supply, or into countries where fresh, unprotected meat easily and speedily decays.

The principle underlying the preservation of meat in air-tight compartments is one well known, namely, the fact that the decay of organic matters is not due simply to oxidation, as was supposed to be the case a few years ago, but to the action of organisms, ferments, oxydases or enzymes, which attack the organic substances, decompose them and resolve them into their original elements or into simpler compounds. If these organisms can be destroyed, or their activity paralyzed, the organic substances remain indefinitely unchanged. The destruction or paralysis of the activity of these organisms is secured in two ways, namely: First, by the process of sterilization by heat, and, second, by the addition of certain chemical substances called antiseptics, which have the property of suspending or paralyzing organic activity. In the preservation of vegetable or animal substances in air-tight packages it is presumed that sterilization by heat is the process which has been followed, as in the majority of cases such sterilization does not impair to any notable extent either the palatability or the digestibility of the preserved food. On the other hand, it is well known that the processes of digestion take place also under the action of certain ferments, and the ingestion of food which has been preserved by chemical means tends to retard or impair the digestive processes. The chemical substances which preserve food from decay without the body interfere to a greater or less extent with the processes of digestion within the body. For this reason hygienic and medical authorities unanimously condemn the use of any so-called preservatives in foods.

Briefly, the process of preserving meat in air-tight packages consists in packing it, after the removal of the bones and subdivision into bits of proper size, as tightly as possible into the packages which have been prepared for it, which are usually made of tin. These packages are securely sealed, with the exception of a small opening, and in this condition are subjected to a temperature of about 220° until the contents of the packages are thoroughly sterilized; in other words, until the organisms capable of effecting decay have been destroyed. It is customary in the case of meat to pour into the can, after packing with the meat, some gelatin or animal fat, which fills all the interstices not occupied by the pieces of meat, so that no gas of any kind is left within the can, except the vapor of water produced by the heat of sterilization. While the can is still hot the opening which has been left is securely sealed. On cooling, the vapor of water which the can contained is condensed and the contents are left out of contact with the air and in a thoroughly sterilized state. In this condition the contents of the package keep indefinitely. If by any means the sterilization be not complete, or if the package be insecurely sealed so that organisms can be introduced from the air, the process of decay will begin after a time, gases will be generated, and the can when opened will show the effect of the stress of the gas within by the escape thereof through the aperture which is first made. The contents of such a package will be found more or less decayed and unfit for use.

In the case of certain meats, such as roast beef and corned beef, it is the custom to cook them before they are chopped and put into the can. The process of cooking, as is well known, does not impair the digestibility of the food. If meat be boiled in water previous to preserving in sealed packages, a portion of the fat may be removed and also some of the soluble nitrogenous compounds which all meats contain. The most important nitrogenous compounds which may be removed by the boiling of the meat are glutin, carnin, kreatin, kreatinin, and sarkin. All these are bodies which are very rich in nitrogen; they are not true proteid bodies, but are known as "flesh bases." These are the bodies which exist chiefly in meat extracts. These bodies are not so nutritious as the insoluble nitrogenous bodies of meat and their abstraction therefrom does not tend to diminish but rather to increase the food value of the meat.

Animal fats when removed from other animal tissues are not easily decomposed, and preserve their freshness without the addition of any preserving agent, or without being placed in air-tight packages, for a greater or less length of time. In the preserving of meats, therefore, some of the fatty tissues are removed and only small portions of animal fat, comparatively, are found in the packages. Preserved meat then consists chiefly of the insoluble, nitro-

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genous elements of the meat, i. e., all those elements which are especially useful in building and restoring tissue. That great class of foods known as carbohydrates is almost entirely unrepresented in meat products, the small quantity of glycogen which exists in meat being practically negligible in comparison with the other nutrients. Preserved meat therefore presents a character of food which is almost exclusively nitrogenous in its nature.

In some kinds of preserved meat tendencies have been shown to the development of a class of bodies known as ptomaines, which are poisonous alkaloidal bodies, resulting from the decay and change of nitrogenous materials in the flesh. These ptomaines, of course, are not developed in perfectly sterilized packages, but may develop in those which are imperfectly sterilized or may develop in sterilized packages which are opened but not eaten for some time after exposure to the air. It is, therefore, highly important in all such cases to be assured that the packages have been thoroughly sterilized, that they are in good condition when opened, and that they are consumed after being opened without any great delay.

The following is the description of the packages which were subjected to examination:

Samples purchased in the open market.

No. 17512. Compressed cooked "corned beef." Prepared by the Armour Canning Company, Chicago, Ill.

No. 17513. Compressed cooked "corned beef." Prepared by the Armour Canning Company, Chicago, Ill.

No. 17514. Compressed cooked "corned beef." Prepared by the Armour Canning Company, Chicago, Ill.

No. 17515. Compressed cooked "luncheon beef." Prepared by the Armour Canning Company, Chicago, Ill.

No. 17523. Prime roast beef. Prepared by the Armour Canning Company, Chicago, Ill.

No. 17524. Rex corned beef. Prepared by the Cudahy Canning Company, Omaha, Nebr.

No. 17525. Corned beef. Prepared by the Armour Canning Company, Chicago, Ill.

No. 17526. "Helmet" luncheon beef. Prepared by the Armour Packing Company, Kansas City, Mo.

No. 17527. "Lion" corned beef. Prepared by the Fairbank Canning Company, Chicago, Ill., Nelson Morris, president.

No. 17528. "Helmet" corned beef. Prepared by Libby, McNeill & Libby, Chicago, Ill.

No. 17529. Corned beef. Prepared by Libby, McNeill & Libby, Chicago, Ill.

Samples obtained from the War Department.

No. 17516. Canned roast beef. Prepared by Libby, McNeill & Libby, Chicago, Ill. Sent from Atlanta, Ga.

No. 17517. Canned roast beef. Prepared by Libby, McNeill & Libby, Chicago, Ill. Sent from Savannah, Ga.

Of the 11 samples purchased in the open market, 8, from five different packing houses, were corned beef. Two samples, one packed by the Armour Canning Company, of Chicago, and one by the Armour Packing Company, Kansas City, were luncheon beef, and one sample was roast beef.

The labels of the two samples obtained from the War Department were almost identical, the only difference being the position of a small shield. To one of the cans, however (No. 17516), gelatin had been added to fill the spaces between the particles of meat; while in the case of the other sample (No. 17517), fat was used instead.

In every case, both in the samples purchased in the open market and in those obtained from the War Department, the contents of the cans were in excellent preservation, and the surfaces of all the cans were markedly concave, showing that no decomposition had begun. This was also indicated by the fact that when the cans were opened there was an appreciable influx of air; while in the presence of even incipient decomposition the surfaces of the cans are usually slightly convex, and, on opening, an outflow of air may always be noticed.

A careful examination was made for all of the preservatives which are ordinarily employed in meat products, namely, borax and boric acid, sulphites and sulphurous acid, salicylic and benzoic acids. No traces of these preservatives were found in any case.

An examination was also made for the presence of saltpeter. The presence of saltpeter was confirmed in all of the samples of corned beef and luncheon beef. No trace was found in any sample of roast beef. The quantitative examination of the corned beef and luncheon beef, however, showed that the amount of saltpeter present was very small, varying from 0.02 of one per cent to 0.145 of one per cent. Only in two cases did the amount exceed 0.09 of one per cent.

Common salt was also present to a considerable extent, though the approximate amount of that ingredient which was used can be determined very readily by the taste, and the amount present is naturally not greater than is desired by the consumers of the meat, nor than would be added in its preparation in private families. The percentage of salt present was not determined by analysis.

It is a matter of common information that in the preparation of corned beef, salt and saltpeter are always used, whether it be in a large packing house or in a private family. All recipes for its preparation published in encyclopedias and in the correspondence columns of our agricultural papers and similar publications, prescribe the use of both salt and saltpeter, and corned beef prepared according to these recipes would ordinarily contain at least as much salt and a greater quantity of saltpeter than is found in the samples mentioned in this report.

Only a preliminary examination has been made for lead and tin in the contents of the cans. The method employed was not sufficiently delicate to reveal mere traces, but if these metals were present in a sufficient quantity for their exact estimation it would indicate that fact. So far as can be determined by chemical analysis, the samples of meat examined were entirely appropriate for use as food.

A statement in German, of which the following is a translation, occurs on the label of the packages of the Armour Canning Company, of Chicago, Ill.: "These cans comply with every requirement of the laws of the German Empire in respect to the presence of lead and zinc."

Although this claim is only made by one company it was equally true of the receptacles of all the packages examined. It would appear from this that the companies are canning their goods largely to supply the foreign market, but at the same time make no distinction between the goods exported and those sold in this country.

APPEARANCE OF THE MEATS WHEN THE CANS WERE OPENED.

It is highly important from a dietetic point of view to make a careful examination of the appearance of the meats when the cans are opened. Any imperfect sterilization or imperfect closing of the apertures of the cans will usually reveal its effects first upon the surface of the meat. A critical examination of the surface will in these cases lead the cook to reject the sample as unfit for use.

The appearance of one of the packages of meat after it had been removed from the can is described here, and is fairly applicable to all the specimens examined. There were three distinct colors presented, namely: First, the red color, due to the flesh itself; second, the white color, due to the layers of fat upon the surface; and, third, the yellow tints, which arise from the gelatin which has been used in packing the can. It also appeared that some melted fat, as well as gelatin, had been put into the package, or that in the process of sterilization the fat present in the meat had been melted and had come to the surface. Very little fat was found in the interior. In the samples examined the whole external surface of the contents of the package presented a perfectly normal appearance; there was no indication of the action of any ferments of any kind nor any discolorations not due to natural causes.

The packages of meat having been broken in two, not cut, the fractured surface showed no gelatin and only a few patches of fat, the great mass of material consisting of the red flesh of the meat.

On opening the cans it was found in many instances that the tins on the inside were discolored, and it was first considered that actual erosion had taken place. A careful microscopic examination of the surface, however, showed that this assumption was an error. In no

case was the surface of the tin found to be eroded, and the discolorations were due doubtless to the natural effect of the meats upon the tin surface. As is well known, one of the essential constituents of flesh, i. e., proteid matter, contains sulphur in such form that when brought into contact with metal there is a tendency to produce discoloration. This is shown familiarly in the action of the white of the egg upon a silver spoon. A careful examination of the discolorations shown upon the tin of the packages leads us to believe that they are due to the natural action of the proteid matter upon the metal.

In some countries, notably in Germany, the character of the tin used in making packages for preserved foods is fixed by law; in other words, the maximum content of lead which the tin may have is prescribed. In Germany the content of lead is not allowed to exceed 1 per cent. In some examinations which were made some years ago in this Division of the tins used in the preservation of fruits, it was found that in this country a much larger percentage of lead was often present, in one case over 12 per cent of lead having been found in the tin used in the package. We are now conducting an examination of the tin surfaces in order to determine the content of lead they may contain. The results of this examination will be presented in a supplemental report.

Particular attention was also paid to the way in which the packages had been soldered. In every instance we found that the rules prescribed by foreign countries, notably Germany, in regard to this matter had been observed. In other words, the solder had been so applied as not in any case to come in contact with the contents of the package. This is a highly important matter, since it is well known that solder contains a very high percentage of lead and therefore the dropping of solder into the contents of the package or bringing the solder in any way into contact therewith is extremely reprehensible. The method of soldering the cans in all cases examined by us was entirely satisfactory and in no instance did we find any trace of solder in the contents of the can nor did we find the contents of the can in contact with the solder in any instance. The care, therefore, which has been exercised in this particular is entirely satisfactory.

In concluding this preliminary report I again desire to emphasize the fact that preserved foods, especially meats, are not to be preferred to the fresh articles, except in those cases where it is not possible for the articles in a fresh state to be supplied. In the second place, it is highly important that some competent supervising agent be always present to inspect the packages when they are opened in order to detect any failure of complete sterilization in their preparation, or any evidences of incipient or advanced decay in their contents.

When these precautions are observed there is no reason to believe that the ingestion of preserved meats as an article of food, in proper quantities and in properly balanced rations, will in any way interfere with the health or comfort of the person consuming them.

I have the honor to be, very respectfully,

H. W. WILEY,
Chemist.

Approved:
JAMES WILSON,
Secretary.

WASHINGTON, D. C., *January 18, 1899.*